

REMARKS

Information Disclosure Statement

Applicant wishes to alert the Examiner to the fact that application serial number 10/655,744 was filed on September 5, 2003 as a continuation-in-part of the present application.

Serial no. 10/655,744 is also a continuation of an international application, PCT/EP02/02395, in which an International Search Report issued. The attached PTO 1449 form lists the references cited therein, and copies of the non-U.S. patent documents are also enclosed.

The submission of these references is being made to ensure beyond any doubt that applicant has complied with its duty of disclosure here, and should not be construed as an admission that the cited references are relevant to the present application, or that they are even prior art to the present application.

A check in the amount of \$180.00 is submitted herewith to meet the fee for submission of an Information Disclosure Statement after the first office action. If the check is insufficient or not found, please deduct any fees necessary for submission of the present Information Disclosure Statement from Deposit Account 501659.

Allowable claims

The Examiner has indicated claims 27 to 30 to be allowable if drafted in independent form. The present amendment does this, and these claims are believed to now be in allowable form.

Prior art rejections

The Examiner has rejected independent claim 16 and its dependent claims 17 to 26 and 31 to 35 as unpatentable over U.S. Patent no. 5,398,582 A to Loxley et al., alone or in combination with U.S. Patent no. 6,143,073 to Christman et al. or U.S. Patent no. 5,980,629 to Hansen et al.

Claim 16 as amended clearly distinguishes over the prior art, and reconsideration of the rejection is respectfully requested.

Claim 16 now recites a method of producing a quartz glass crucible that comprises preparing a crucible body configured such that the resulting crucible is adapted to receive therein a melt used in a crystal pulling process. The crucible body has a concavity with an inner layer that forms an innermost layer of the resulting crucible that, when said melt is received in the crucible, is in contact with the melt. In at least a portion of the inner layer the formation of cristobalite is induced using a crystallization promoter. The preparing includes introducing the crystallization promoter and a reducing substance into said inner layer. The reducing substance is a substance capable of reacting during the crystal pulling process with gaseous oxygen to produce an oxidized solid.

The claimed combination of crystallization promoter and reducing agent in the method of claim 16 provides a substantial benefit over the prior art. The crystallization promoter has the effect that crystallization occurs in the inner layer, e.g., on heating of the crucible. The reducing substance, by reacting with oxygen during the pulling process to form solid oxide, is able to prevent growth of bubbles of gaseous oxygen that would lead to flaking off of the cristobalite layer, which is a problem in the prior art. The result is a more durable crucible. See, e.g., specification, page 4, lines 16 to 22.

No reference suggests a method providing this advantageous combination.

Loxley et al. discloses a method for producing a quartz glass crucible using a “slip-casting” process, in which a starting SiO_2 substance containing a crystallization promoter is used. An example of the method is discussed at col. 14, lines 59 et seq. The method comprises preparing a slurry of high-purity fused quartz and aluminum acetate particles. The resulting green body is dried and heated in a vacuum to a temperature of about 1170 degrees C, and then is sintered to a high density in a helium atmosphere at a temperature of at least 1700 degrees C.

Loxley identifies as crystallization promoters aluminum compositions that are suitable aluminum oxide precursors. See col. 5, line 22. The preferred substance used is aluminum acetate. Col. 5, lines 25 to 29. . Also mentioned are aluminum silicate and zirconium silicate (col. 5, line 33), and also refractory silica-metal or silica-aluminum (col. 5, line 38). The latter yield 80 -90% by weight of silica and from 10-20% by weight of aluminum oxide after milling. Col. 5, lines 45 – 50. Other silica-oxygen-metal compounds, such as zirconium silicate, can be used. Zirconium silicate decomposes when the green body is sintered, forming zirconium oxide and cristobalite. Col. 6, lines 9 – 11.

All of the substances identified in Loxley’s method as suitable crystallization promoters form stable oxides under the slip-casting process conditions described in Loxley, and none of these oxides can react with oxygen to form oxides during the pulling process. As a result, the Loxley crucible does not contain a reducing substance that can react with oxygen during the pulling process, as recited in claim 16.

Loxley does not suggest any process steps or conditions that would be conducive to formation of a reducing substance in the crucible wall. For example, it may be noted that the aqueous environment created in the slip-casting process in Loxley would not allow formation of

a reducing substance in the crucible wall. It also can be noted that Loxley does not suggest the presence of a reducing atmosphere during sintering of the green body. Even if one were present anywhere in the process, however, no suitable substance is suggested that would be affected by such an atmosphere to result in the presence of a reducing substance as recited in claim 16.

Loxley therefore fails to suggest a process with reducing substance in an inner layer of the crucible body that can react with oxygen to form an oxidized solid, and also fails to provide a crucible with the advantages of the crucible produced by the method of claim 16. Claim 16 therefore distinguishes over the Loxley reference.

The other references, Christman and Hansen et al., that are argued in combination with Loxley do not invite such a combination, and also fail to suggest providing a crystallization promoter and a reducing substance in an inner layer of the crucible.

Christman shows a method of making a quartz glass crucible using an arc-melting process in which silica particles are melted by directing them toward a crucible wall through an arc generated between electrodes. See, e.g., claim 1. To reduce silica vapor condensation on the electrodes, a protective of non-reactive gas is blown over the electrodes. Col. 4, lines 20 – 24. Suitable gases for this purpose are neon, helium, argon and nitrogen. Col. 4, lines 41 – 46.

There is no teaching in Christman to introduce any substance other than SiO_2 into the inner wall of the crucible. No doping agent is mentioned, no adding of crystallization promoter is mentioned, and, most importantly, no substance is placed in the wall of the crucible that could react with gaseous oxygen during the pulling process to form an oxidized solid. Christman therefore also fails to suggest the claimed method.

Hansen et al. discloses a method for enhancing thermal stability of quartz glass crucibles similar to some prior art methods discussed in the present application. See specification, page 1,

last paragraph. This enhancing is done by providing a surface layer of cristobalite by treating the glassy inner and outer walls of a commercially available crucible of opaque, bubble-containing quartz glass with a chemical solution containing substances conducive to the devitrification of quartz glass into cristobalite. Many substances are recommended as crystallization-promoting agents. See col. 6, lines 1 – 17. Alkaline earth metals are particularly preferred. See col. 6, lines 23-33.

Hansen also fails to teach or suggest introduction of a reducing substance into the inner layer of the crucible body. The crystallization promoters used in Hansen cannot have any reducing effect during the pulling process, and therefore cannot react with the gaseous oxygen in the crucible wall to form an oxidized solid. While the alkaline earth metals mentioned in Hansen can be readily oxidized in metal form, it would be technically and chemically impossible in the Hansen process to introduce alkaline earth metals in their metallic state into the wall of the crucible. If a sufficiently fine alkaline metal powder were used, it would immediately react with the oxygen in the air to form the associated metal oxide, and once formed, the alkaline metal oxide cannot work as a reducing substance. Even if the crucible were then subjected to reducing conditions, these would only cause reduction of the silica glass instead of causing a reduction of the alkaline earth metal oxides.

Hansen therefore also fails to suggest the reducing substance in the inner layer of the crucible that can react with oxygen during the pulling process, as required by claim 16.


Claim 16 therefore distinguishes over the cited references, and withdrawal of the rejection thereof is respectfully requested.

Claims 17 to 26 and 31 to 35 depend directly or indirectly from independent claim 16, and therefore distinguish therewith over the prior art.

All claims herein having been shown to distinguish over the prior art in structure,
function and result, formal allowance is respectfully solicited.

Should any questions arise, the Patent Office is invited to telephone attorney for
applicants at 212-490-3285.

Respectfully submitted,



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